Many Suspects, But No Culprit

Colony collapse disorder (CCD) has been a subject of interest in scientific journals and the popular media since the syndrome first appeared in 2006. Despite numerous and differing claims, nothing has actually been shown to be the cause of the problem.

Pathogens

One or more pathogens remain scientists' most likely choice as the cause or partial cause. But various viruses and bacteria have had higher correlations with CCD in different parts of the United States and in different countries. Before any pathogen can be legitimately accepted as the cause, science must demonstrate that when it is introduced into a healthy colony, CCD results.

Parasites

A parasite is the other perennial suspect, either by itself or in combination with one or more pathogens. *Nosema* and *Varroa* mites remain high on the probable-cause list.

New pests or diseases

Some believe that a previously undiscovered or unidentified pest or pathogen is involved in CCD. But claims that such an agent has been identified have not held up scientifically so far.

Pesticides

There are many classes of pesticides to which honey bees can become exposed. Among those that have been stamped with a "CCD cause" label are the neonicotinoids, like imidacloprid and clothianidin. One issue with making that link is the lack of a matching pattern between neonicotinoid residues in colonies and CCD outbreaks. France, which banned imidacloprid in 1999, and Germany, which along with France banned clothianidin in 2008, still have CCD problems.

Transportation stresses from migratory beekeeping

Pollination-service beekeepers stack colonies on tractor-trailers and transport them thousands of miles during the growing season. For honey bees, orientation to their hive is vital, and being regularly relocated must be stressful. Additionally, moving hives around the country may spread diseases and pathogens as honey bees intermingle in the fields. It is possible that such stresses play into CCD, but there is no scientific evidence of it at this time.

Monoculture

Wild honey bees forage on a wide variety of nectar sources. Honey bees used for commercial pollination are mostly limited to one crop at a time, and it is possible that they may suffer nutritional deficiencies that stress their immune systems.

Genetically modified crops

Genetically modified (GM) crops, most commonly *Bt* corn, have been offered up as the cause of CCD. But there is no correlation between where GM crops are planted and the pattern of CCD incidents. Also, GM crops have been widely planted since the late 1990s, but CCD did not appear until 2006. In addition, CCD has been reported in countries that do not allow GM crops to be planted, such as Switzerland. German researchers have noted in one study a possible correlation between exposure to *Bt* pollen and compromised immunity to *Nosema*.

High-fructose corn syrup

Some researchers have attributed CCD to the practice of feeding high-fructose corn syrup (HFCS) to supplement bee colonies. But there are many reports of CCD occurring in the apiaries of beekeepers who do not feed HFCS. Others have suggested a possible connection with HFCS produced from genetically modified corn, combining two popular villains. But the simple management change of not feeding any HFCS does not stop CCD.

Global climate change

Weather changes, such as unusually warm winters, earlier springs, drought, and flooding, can lead to changes in flowering times. Plants may blossom early, limiting nectar and pollen supplies. But bees used for pollination contracts are moved to fields to coincide with flowering of crops. Still, some believe global warming is to blame, if only in part, for CCD.

Ozone

The level of the air pollutant ozone has been steadily dropping since the early 1990s. Since CCD did not appear until 2006, the timing doesn't match for ozone to be related.

Cell phones and cell phone towers

The idea of cell phones causing CCD began with the misinterpretation of a study in which a cordless home phone, not a cell phone, was shown to have some impact on honey bee navigation. The study author has repeatedly stated that the phone he tested is nothing like a cell phone and has nothing to do with CCD. But the idea remains popular. One of the most recent "proofs," (published in *Current Science* in 2010) claimed evidence suggesting "that colony collapse does occur as a result of exposure to cell phone radiations" while also reporting that the impact of cell phones in both of the test hives resulted in more bees staying in the hive longer—the exact opposite of the definition of CCD.*